

REMARKS

Claim 1, 4, 14-19 and 22-32 are pending and under consideration. All other claims have been cancelled.

In the Office Action of June 18, 2007, all of the claims were finally rejected as anticipated by Imamasu (JP 10-312789) and Kamauchi et al. (US 5705296). Moreover, the claims were objected to as failing to comply with the written description requirement and as not enabled.

Additionally, the last changes to the specification were objected to.

In response, claims 1, 4, 19, 22 and 32 have been amended. The paragraphs changed in the last amendment have again been amended. No new matter has been introduced.

Regarding the changes to the specification, the paragraph bridging pages 6 and 7 has been changed to delete the allegedly confusing formula. The intent, as is clear from the remainder of the specification is to describe that various metal and semiconductor containing materials, be they compounds or alloys, with or without Li can be used in the anode, so long as they themselves form compounds or alloys with Li.

The first full paragraph on page 7 has also been amended to make this clearer, and to note that tin and silicon containing materials are preferred, with silicon containing materials being most preferred. The objected to alloy has been deleted.

Regarding the rejection of the claims under 35 USC 112, the claims have been amended to recite the language used in the specification. Referring to the published version of the application (US 2005/0053835), support can be found at the following locations (emphasis added):

For the use of “consisting of” in connection with the anode:

[0013] This non-aqueous electrolyte secondary cell uses the anode molded only from an active material and/or conductive agent and can increase the anode active material filling density because no binder is used, thereby enabling to obtain an anode having a large reaction area.

For the use of the term “binderless” for the sintered carbon material:

[0028] The anode material capable of doping/dedoping lithium is a material containing sintered carbon material prepared by sintering a carbon material capable of doping/dedoping lithium. The carbon material constituting the sintered carbon material may be, for example, non-graphitizable carbon, graphitizable carbon, or graphite. This sintered carbon material is prepared by sintering a carbon material and not containing a binder.

For the use of a tin or Li containing metal material capable of forming a compound or alloy with Li:

[0029] Moreover, the anode may be prepared by using a-metal or a semiconductor capable of forming an alloy or compound together with lithium or the alloy or compound thus obtained. The metal, alloy, or the compound can be expressed, for example, by $D_{\text{sub}}sE_{\text{sub}}tLi_{\text{sub}}u$. In this chemical formula, D represents a metal element or a semiconductor element capable of forming an alloy or compound together with lithium. Moreover, the s, t, and u values are as follows: $s > 0$, $t \geq 0$, and $u \geq 0$.

[0030] Here, the metal element or semiconductor element capable of forming an alloy or compound together with lithium is preferably a metal element or semiconductor element of 4B group and especially preferable is silicon or tin. The most preferable is silicon. These alloys or compound are preferably, $SiB_{\text{sub}4}$, $SiB_{\text{sub}6}$, $Mg_{\text{sub}2}Si$, $Mg_{\text{sub}2}SaANi_{\text{sub}2}Si$, $TiSi_{\text{sub}2}$, $MoSi_{\text{sub}2}$, $CoSi_{\text{sub}2}$, $NiSi_{\text{sub}2}$, $CaSi_{\text{sub}2}$, $CrSi_{\text{sub}2}$, $Cu_{\text{sub}5}Si$, $FeSi_{\text{sub}2}$, $MnSi_{\text{sub}2}$, $NbSi_{\text{sub}2}$, $TaSi_{\text{sub}2}$, $VSi_{\text{sub}2}$, $WSi_{\text{sub}2}$, or $ZnSi_{\text{sub}2}$, and it is possible to use an electrode formed by using these materials.

For the specific recitations relating to metal materials in claims 22, 29 and 32:

Original claim 22, and

[0030] Here, the metal element or semiconductor element capable of forming an alloy or compound together with lithium is preferably a metal element or semiconductor element of 4B group and especially preferable is silicon or tin. The most preferable is silicon. These alloys or compound are preferably, $SiB_{\text{sub}4}$, $SiB_{\text{sub}6}$, $Mg_{\text{sub}2}Si$, $Mg_{\text{sub}2}SaANi_{\text{sub}2}Si$,

TiSi.sub.2, MoSi.sub.2, CoSi.sub.2, NiSi.sub.2, CaSi.sub.2, CrSi.sub.2, Cu.sub.5Si, FeSi.sub.2, MnSi.sub.2, NbSi.sub.2, TaSi.sub.2, VSi.sub.2, WSi.sub.2, or ZnSi.sub.2, and it is possible to use an electrode formed by using these materials.

Regarding the rejection of the claims as anticipated, it is submitted that the cited prior art does not teach using an anode consisting of sintered carbon material and the recited conductive agent.

In that regard Kamauchi et al. specifically notes in the paragraph immediately preceding the brief description of the drawings (emphasis added):

The positive electrode further comprises a binder and an electrical conducting agent having particle sizes of 0.02 through 20 times that of the positive electrode active material. The preferable porosity of the positive electrode is 25 through 60%.

Imamasu similarly uses a binder.

As noted in the present application:

[0031] When using a carbon material as an anode active material, conventionally, a carbon material powder and binder are kneaded to prepare an anode composite mixture, which is formed in to a desired electrode form or retained by a current collector to constitute the anode. In such an anode, the use of the binder reduces the anode active material filling density and as a result it is impossible to sufficiently increase the cell energy density.

[0032] In contrast to this, when a carbon material is pressed into a desired electrode form and sintered in an inert gas at a predetermined temperature to obtain a sintered carbon material, since no binder is used, it is possible to increase the anode active material filling density and obtain an anode having a large reaction area. By using the anode containing the sintered carbon material prepared by sintering a carbon material, the cell energy density and the charge/discharge efficiency are improved.

Examples 1 and 2, and Comparative example 2 discussed in the specification use the binderless anodes. Regarding Comparative examplpe 2, the specification notes:

[0068] Moreover, Comparative Example 2 having the anode containing the sintered carbon material prepared by sintering a carbon material and the cathode containing LiCoO_2 as the lithium composite oxide and Comparative Example 3 having the cathode containing LiFePO_4 but the anode made from the anode composite mixture prepared by kneading carbon material powder and binder show an improved discharge capacity recovery ratio as compared to Comparative Example 1 but the discharge capacity recovery ratio is deteriorated by 10% or more when stored for a long period of time.

Examples 1 and 2 show an overall improved discharge capacity recovery ratio and storage period.

The result is that the use of a binderless anode material in combination with the recited cathode active material comprising $\text{Li}_x\text{Fe}_y\text{PO}_4$ and having a particle diameter not greater than 1 micrometer (wherein $0 < x \leq 2$ and $1 \leq y \leq 2$) is demostably different and better than what the prior art conventionally teaches. Accordingly, the claims, as amended recite subject matter not anticipated by the cited prior art nor fairly obvious in view of the cited prior art.

In view of the foregoing, it is submitted that the pending claims are allowable and that the application is in condition for allowance.

Respectfully submitted by,

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